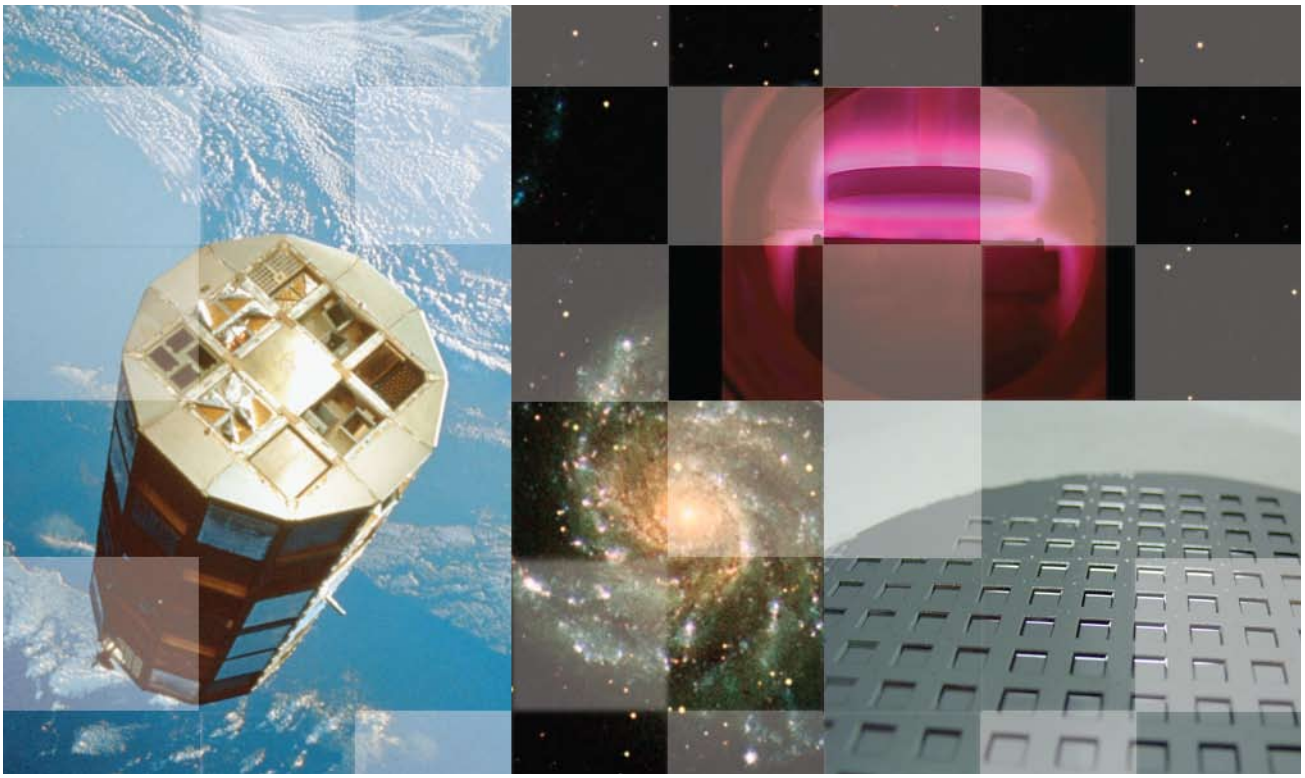
National Aeronautics and Space Administration

technology opportunity

Surface Interaction Model for Enhanced Particulate Distribution Analysis



NASA Goddard Space Flight Center invites companies to license the particle surface interaction model (SIM), which predicts the behavior of solid particles that contact a surface in a low-pressure environment. Inserting the SIM into a larger particle transport simulator allows for a more accurate picture of particle behavior. This is of particular importance in the contamination analysis of spacecraft as well as in non-aerospace applications, such as microelectronics.

Benefits

- **Detailed**: The SIM gives individual particulate information for any number of particles, resulting in more detailed data output regarding contamination distribution.
- **Accurate**: Because the SIM models behavior rather than material parameters, the particle analysis is more accurate for mixed or unknown material populations.
- **Easy to use**: Only four input parameters are needed to run the SIM.

Applications

The SIM is ideal for use in applications where particle contamination is of concern:

- Spacecraft, rovers, or other equipment on lunar surface
- Vacuum deposition equipment
  - – Semiconductor devices
  - – Microelectromechanical (MEMS) devices
  - – Thin-films deposition
- Vacuum microscopy and lithography
- Optical components

Technology Details

How it works

Modeling particle contamination allows researchers to predict what a particle's impact on a process or application may be. By knowing a particle's trajectory, including trajectory changes due to bouncing off an object and/or the fact that it may have stuck to the object, researchers can determine (and possibly change) where a particle may end up.

The SIM is an algorithm to determine a particle's interaction with a surface using four particle behavior parameters. The advantage in using behavioral parameters versus material parameters is that particles of the same material may behave differently, and particles of differing materials may behave the same. Using behavioral parameters overcomes this particle capriciousness.

The SIM is used within a larger transport modeling system, such as a direct simulation Monte Carlo (DSMC)-based particle transport model. This larger system calculates a particle's behavior in free flight and then passes variables such as a particle's velocity and angle of incidence to the SIM. The SIM then determines the particle's interaction with the surface and returns the data to the larger program. Surface interactions might include whether the particle adhered to the surface or in what direction and with what velocity it bounced off the surface.

Why it is better

The SIM greatly advances the modeling of particle transport, which currently is a poorly developed science. Current models are mainly bulk transport models, analyzing particles in fluidized beds (e.g., corn flowing in a hopper) or particles dispersed in a low-pressure medium via stream flow or diffusion (e.g., Environmental Protection Agency models). No models currently account for the way particles interact with a surface, bouncing around, bouncing off of, or adhering to surfaces when they impact. Without this algorithm, it would be difficult to predict how contaminants could be spread in low-pressure environments such as within spacecraft enclosures.

By using empirically determined behavioral properties as input parameters, the SIM predicts the motion of individual particles interacting with a surface. The algorithm can be applied to any number of particles, resulting in detailed data that accurately predicts the transport of contaminants. The SIM is easy to use, because it needs only four input parameters that are readily available: coefficient of restitution, coefficient of momentum transfer, diffusivity, and sticking velocity.

Patents

NASA Goddard has filed a patent application for this technology.

Licensing and Partnering Opportunities

This technology is part of NASA's Innovative Partnerships Program (IPP), which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing the Hughes Particle–Surface Interaction Model technology (GSC-15364-1) for commercial applications. For information and forms related to the technology licensing and partnering process, please visit the Licensing and Partnering page on Goddard's IPP Office Web site (http://ipp.gsfc.nasa.gov/lic-partnerships.html)

For More Information

If you are interested in more information or want to pursue transfer of this technology (GSC-15364-1), please contact:

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